

Striking now the arc ab , fig. 16 *b*, of radius equal to the outside lap and the arc cd of radius equal to the inside lap, the history of events may be traced very simply.

Thus at the valve is just about to open, i.e. C is the position of the main crank at *admission*; pn is the opening of the valve at dead centre, i.e. pn is the *lead*; b corresponds to *cut-off*, i.e. C_2 ; and so on.

Crank Side of Piston.—If the engine is symmetrical, these diagrams can be used directly for the valve design for this side of the piston. They, of course, have to be rotated through 180° to give correct main-crank positions for the different events. If the engine is unsymmetrical a new set of diagrams will be required for the crank side of the piston in a double-acting engine.

In some cases when piston valves are used, steam is admitted at the inner edges and exhausted at the ends. The eccentric is then placed at an angle of 180° with an eccentric for driving a valve with "outside admission," the crank thus leading in the direction of rotation. All investigations in designing can be made on the bases of outside admission, the eccentric being keyed to the shaft in the position mentioned.

Valves, Valve Gear, and Eccentrics.—As stated above, the steam and exhaust valves for large stationary engines are now nearly always of the drop-valve type, and a number of illustrative examples are given. In many cases the valves are operated by eccentrics mounted on a lay shaft driven by either bevel or spiral gear from the main shaft.

The high-pressure valves are worked through a device containing a member which is automatically put into gear with the lever lifting the valve spindle in order to open the valve at the proper time, but which is disengaged by its coming into contact with another member some time during the opening movement. The position of this member is regulated by the governor. The valve lever being thus released, the valve closes, partly by its own weight (for these valves always move vertically, and open upwards) and partly by the force of a spring acting upon the upper end of the valve spindle. The power developed by the engine is thus controlled by alteration to the cut-off between the limits of speed for which the governor is

designed. Corliss valves are operated in the same way, the only difference being that the motion is angular instead of up and down. The variety of such " slip " or " trip " gear is endless, much ingenuity having been spent upon their design under the belief that a sharp cut-off greatly improves the economy,

The superior performance of engines fitted with this type of gear is the result mainly of a combination of other factors, such as reduced clearance volume, for the valves can be placed almost inside the cylinder; the use of separate ports for inlet and exhaust, which greatly reduces initial condensation; and the good drainage owing to the exhaust valves being placed at the bottom of the cylinders in horizontal engines. The valves also close much more tightly than either piston or slide valves.

The property of being able to vary the cut-off gives a ready means of meeting varying demands for power throughout a wide range, and this